N00158.AR.000478
NASJRB WILLOW GROVE
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FINAL TASK SPECIFIC PLAN BUILDING 77 FOOTPRINT SCOPING SURVEY NAS WILLOW GROVE PA
10/01/2014
TETRA TECH INC

Final

Task Specific Plan
Building 77 Footprint
Scoping Survey

Naval Air Station Joint Reserve Base
Willow Grove
Horsham, Pennsylvania

October 2014

Prepared for:
Department of the Navy
Base Realignment and Closure
Program Management Office Northeast
Philadelphia, Pennsylvania

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Prepared under:
Naval Facilities Engineering Command
Contract Number: N62470-08-D-1001
Task Order: WE42

FINAL

TASK SPECIFIC PLAN
BUILDING 77 FOOTPRINT
SCOPING SURVEY

NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE
HORSHAM, PENNSYLVANIA

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REVIEW AND APPROVAL

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ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
BRAC	Base Realignment and Closure
cpm	counts per minute
DFW	definable feature of work
DoD	Department of Defense
DQO	data quality objective
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
FSS	Final Status Survey
GPS	Global Positioning System
HASP	Health and Safety Plan
HRA	Historical Radiological Assessment
IRP	Installation Restoration Program
JRB	Join Reserve Base
LBGR	lower boundary of the gray region
LLRW	Low Level Radioactive Waste
m^2	square meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
$MDCR_{SURVEYOR}$	minimum detectable count rate calculated assuming a surveyor efficiency
mrem/y	millirem per year
NaI	sodium iodide
NAS	Naval Air Station
NRC	U.S. Nuclear Regulatory Commission
OSWER	Office of Solid Waste and Emergency Response
pCi/g	picocuries per gram
PHP	Project Health Physicist
Ra-226	radium-226
RASO	Radiological Affairs Support Office
RCT	Radiological Control Technician
RESRAD	Residual Radioactivity computer code
RI	Remedial Investigation
ROC	radionuclide of concern
RWP	Radiation Work Permit
SOP	Standard Operating Procedure

Sr	strontium
Sr-90	strontium-90
SS	Scoping Survey
SSO	Site Safety Officer
TSP	Task-specific Plan

TASK-SPECIFIC PLAN FOR BUILDING 77 FOOTPRINT SCOPING SURVEY

This Task-specific Plan (TSP) provides the details for the Scoping Surveys of the Building 77 footprint at the former Naval Air Station (NAS) Joint Reserve Base (JRB) Willow Grove, Pennsylvania. The survey will be conducted in accordance with the general approach, radiological controls and methodologies provided in the Basewide Radiological Management Plan (Management Plan) [Tetra Tech 2014a] and Standard Operating Procedures (SOPs)[Tetra Tech 2014a, Attachment 4]. The survey activities will conform to the requirements of the Health and Safety Plan (HASP) [Tetra Tech 2014b]. No exceptions to the SOPs or HASP are noted.

This survey is being performed, as recommended in the Historical Radiological Assessment (HRA)[Tetra Tech 2013) to determine if residual radioactivity is present in the surface soil (0-6 inches) within the Building 77 footprint. The survey of this area has been designed as a Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) NUREG-1575 Class 3 survey [DoD et al. 2000] based on historical records and the little or no potential for delivering a dose above the release criterion. This methodology will allow the use of survey data to assess the risk posed by the presence of residual radioactivity in surficial soils.

1.0 SITE DESCRIPTION AND HISTORICAL SUMMARY

Building 77 was built in 1950 for use as an Administrative Building (Figure 1). Prior to 1975, it was used by the Supply Department. The building was used as the AIMD Paraloft prior to 1979, when paraloft operations were moved to Building 180 and again later in 1996. Parachute operations include not only the repacking of parachutes, but also the maintenance of survival kits consisting of items such as compasses and personnel markers for locating stranded individuals. The building was torn down in the late 1990s. The size of the long, one-story, wood-frame building was approximately 6,144 square feet. A 1997 drawing for this building does not label the locations of operational portions of the building. A 1996 survey found asbestos in this building. Figure 2 shows the approximate location of Building 77.

The radionuclides of concern (ROC) suspected for this building are radium 226 (Ra-226) and strontium 90 (Sr-90) [Tetra Tech 2013].

2.0 SCOPING SURVEY

The purpose of this section is to provide guidance for performance of a Scoping Survey (SS) under this TSP. This SS will allow the use of survey data to assess the risk posed by the presence of residual radioactivity in surficial soils.

All radiological surveys will be performed in accordance with SOP 006, *Radiation and Contamination Surveys*. One hundred percent of the Class 3 survey unit that is unpaved will be scanned using a Ludlum Model 2241 (or equivalent) survey meter with a 44-10 2-inch by 2-inch NaI detector coupled with a Trimble Pro XRS + TSCe GPS survey system for data collection and data maintenance [Tetra Tech 2014a]. Additional measurements and samples will be

collected if investigation levels or release criteria are exceeded during the review of data. Biased gamma static measurement, exposure rate measurement, and soil sample locations will be based on the results of the gamma walkover survey and on professional judgment.

Soil samples will be analyzed for radium 226 (Ra-226) and total strontium (Sr) by a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) approved laboratory. If any total Sr result exceeds the release criterion for Sr-90, that sample will be analyzed for Sr-90, and verified to be less than the Sr-90 release criterion. [Tetra Tech 2014a, Attachment 3]

2.1 RELEASE CRITERIA

This survey is being performed to assess whether residual radioactivity above the established release criteria, as defined on Table 2-1, is present in the area. The site will be modeled using residual radionuclide concentrations to evaluate total dose and risk.

2.2 REFERENCE AREA

The reference area will be selected with the concurrence of the Navy Radiological Affairs Support Office (RASO). The reference area will contain the same physical and geological characteristics as the survey area and will have no history of radiological operations. A minimum of 16 soil samples will be collected at the 0-6 inch depth. These samples will be analyzed by an offsite DoD ELAP-accredited laboratory for Ra-226, total Sr and isotopic U. A static gamma measurement and a gamma exposure measurement will be obtained from each survey location. A GPS correlated gamma walkover survey will be performed of the reference area. The reference background area results will be included in the survey report.

The reference area identified in the IR Site 3 TSP will be evaluated for applicability to the Building 77 footprint. Additional reference areas may be selected by the Radiation Safety Officer Representative, in consultation with the RASO, if the physical and geological characteristics of the IR Site 3 reference are differ from those associated with the Building 77 footprint.

2.3 INVESTIGATION LEVEL

The investigation level for gamma scan surveys will be established at the survey unit mean plus 3σ, where σ is the standard deviation of the gamma readings in the survey unit. Survey data will be evaluated using the Z-test and values above the mean will be plotted on a color coded map. Values of 3σ or above will be investigated by 1) visual inspection, 2) physical inspection and 3) static gamma measurements. If the source of the elevated reading cannot be determined (i.e., geologic sources, naturally occurring observable sources, etc.), a biased soil sample from the location will be considered. Approximately 25% of the areas exceeding the 3σ value will be sampled. Samples will be biased towards areas within the footprint of the identified burial trenches. Areas exceeding 3σ will be marked in case laboratory analyses of soil samples indicates that further investigation is warranted.

2.4 SURVEY UNITS

A single survey unit has been identified for investigation within the Building 77 footprint (Figure 2). The survey unit was based on the historical location of facility operations. Since portions of the Building 77 footprint are currently covered with asphalt paving and concrete curbing, only those areas accessible for gamma walkover (i.e., open vegetated and non-paved areas) surveys will be considered for gamma survey. Survey locations adjacent to curbing/soil interfaces may be relocated to avoid sampling through concrete.

2.5 ESTABLISHING THE NUMBER OF MEASUREMENTS

To determine the number of measurements, N, to be taken per survey unit/reference area combination when the contaminant is present in background, Equation 5-1 of MARSSIM (NRC 2000) is used:

$$N = \left(\frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3(P_r - 0.5)^2} \right)(1.2)$$

Where:

N = Number of data points

$Z_{1-\alpha}$ = Type I decision error level, 1.645

$Z_{1-\beta}$ = Type II decision error level, 1.645

P_r = random measurement probability, 0.871014

1.2 = 20 percent increase in number of samples over the minimum

The values used in the calculation are from MARSSIM guidance (NRC 2000) and are based on a recommended value for the relative shift (Δ/σ) of 1.6 as discussed in Section 5.5.2.2 of MARSSIM (NRC 2000). Type I and Type II decision errors are based on 0.05 false negative and 0.05 false positive rates. The associated Z values are obtained from MARSSIM Table 5.2 (NRC 2000). The random measurement probability, P_r, is from MARSSIM Table 5.1 (NRC 2000).

Using the defined values, the equation becomes:

$$N = \left(\frac{(1.645 + 1.645)^2}{3(0.871014 - 0.5)^2} \right)(1.2)$$

The calculation results in a value of N = 31.45366. Therefore, a minimum of 32 measurements will be obtained in each survey unit/reference area combination. Sample locations will be determined using a triangular grid pattern as specified in Section 4.4.2 for the Basewide Radiological Management Plan [Tetra Tech 2014a].

In additional to the systematic measurements, biased sampling locations may be determined based on the results of the gamma walkover survey and field observations/investigations. Each sample location investigation will consist of:

- a soil sample from the 0-6 inch (0-15 cm) soil layer (SOP 009) [Tetra Tech 2014a, Attachment 4].,
- a static 1-minute gamma measurement at non-paved locations (SOP 006) [Tetra Tech 2014a, Attachment 4] and,
- a gamma exposure rate measurement at non-paved locations (SOP 006) [Tetra Tech 2014a, Attachment 4].

GPS coordinates will be obtained for all sample locations.

2.6 GAMMA SCANS

Only those non-paved portions of the building footprint will be scanned with a Ludlum Model 2241 survey meter (or equivalent) with a Ludlum 44-10 2 inch by 2-inch NaI detector coupled to a GPS data collection and data maintenance system. This process is detailed in section 8.2.2 of the Management Plan [Tetra Tech 2014a]. Gamma scans by survey instruments will be logged, submitted to RASO for review and included in the final report. For the Ludlum 2241 with a 44 10 2-inch by 2-inch NaI detector, scans will be performed at a rate of approximately 0.5 meter per second (1 second scan observation) with the detector held approximately 10 centimeters (4 inches) above the ground. The detector will be moved back and forth across the travel path while scanning, producing a serpentine scan pattern.

2.6.1 Minimum Detectable Count Rate for Gamma Surveys (2-inch by 2 inch NaI Probe)

The minimum detectable count rate (MDCR) is the minimum detectable number of net source counts in the scan interval, for an ideal observer, that can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in d'), as shown in Equation 7-5 from the Management Plan [Tetra Tech 2014a]:

Equation 7-5 from the Management Plan

$$MDCR = d' \sqrt{b_i} \left(\frac{60}{i} \right)$$

Where:

$MDCR$	=	minimum detectable count rate
d'	=	index of sensitivity (α and β errors) = 3.28
b_i	=	number of background counts in scan time interval
i	=	scan or observation interval = 1 second

The calculated MDCR value will be determined after reference background measurements have been obtained. The required rate of true positives is 95 percent, and the rate of false positives is 5 percent. From Table 6.5 of MARSSIM (DoD et al. 2000), the value of d', representing this performance goal, is 3.28.

2.6.2 MDCR and Use of Surveyor Efficiency, Gamma (2-inch by 2 inch NaI Probe)

The MDCR calculated assuming a surveyor efficiency ($MDCR_{SURVEYOR}$) can be calculated assuming a surveyor efficiency (P) of 0.5 and the observed background count rate obtained from reference background measurements, using Equation 7-9 from the Management Plan [Tetra Tech 2014a]:

Equation 7-9 from the Management Plan

$$MDCR_{SURVEYOR} = \frac{MDCR}{\sqrt{0.5}}$$

2.7 STATIC GAMMA MEASUREMENTS

Static gamma measurements will be collected at the non-paved sample locations in the survey unit using a Ludlum Model 2241 survey meter with a Ludlum 44-10 2-inch by 2-inch NaI detector. The gamma measurements will be collected in accordance with SOP 006 [Tetra Tech 2014a, Attachment 4].

For gamma surveys, the MDC is calculated in cpm. Equation 7-12 from the Management Plan [Tetra Tech 2014a] is used to calculate the MDC:

Equation 7-12 from the Management Plan

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{T_B}$$

Where:

3+4.65	=	constant factor provided in MARSSIM (DoD et al. 2000)
R_B	=	background count rate (cpm)
T_B	=	background counting time (minute) = 1

Using the inputs observed from the reference background area in Equation 7-12, the MDC for the Ludlum Model 2241 with a 44-10 2-inch by 2-inch NaI detector will be calculated.

2.8 GAMMA EXPOSURE RATE MEASUREMENTS

Gamma Exposure rate measurements will be collected at the non-paved sample locations using Ludlum Model 19 scintillation detectors from each specified sample location in the survey unit in accordance with SOP 006 [Tetra Tech 2014a, Attachment 4].

2.9 SOIL MEDIA SAMPLING

Survey Unit soil samples will be collected at the sampling locations and analyzed by an offsite DoD ELAP-accredited laboratory for Ra-226 and total Sr (GL-RAD-A-004 and 013) [Tetra Tech 2014a, Attachment 3]. Summary, statistics and data evaluation will be presented to RASO and summarized in SS report.

2.10 DOSE MODELING IN SUPPORT OF A RADIOLOGICAL RISK ASSESSMENT

The intent of the survey is to provide radiological risk analysis for residual contamination in surficial soils (0 – 6 inches) within the Building 77 footprint. To accomplish this goal, it is necessary to provide a means for calculating residual dose to the critical group; the default residential farmer scenario for RESRAD (version 6.5 or as updated) was selected.

After the residual dose is determined, the Department of the Navy will also determine the excess lifetime cancer risk to the critical group. These values will be provided in the SS report to demonstrate that the net residual dose is less than 15 mrem/y (equivalent to 3 x 10^{-4} excess lifetime cancer risk per Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-18 [EPA 1997]).

3.0 QUALITY CONTROL

The DQOs for the survey are provided on Table 3-1.

Definable features of work (DFWs) establish the measures required to verify both the quality of work performed and compliance with project requirements. The DFW for this task are radiological surveys and the associated sample results. A description of the DFW and the associated phases of quality control are presented in Table 3-2. Quality control data will be provided in the SS report.

4.0 ENVIRONMENTAL PROTECTION

Environmental protection-driven requirements addressed in the Management Plan [Tetra Tech 2014a] apply to this TSP. No additional requirements are necessary.

5.0 REFERENCES

AEC (Atomic Energy Commission). 1974. Regulatory Guide 1.86. Termination of Operating Licenses for Nuclear Reactors. June.

DoD (Department of Defense), Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency. 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, Revision 1. August.

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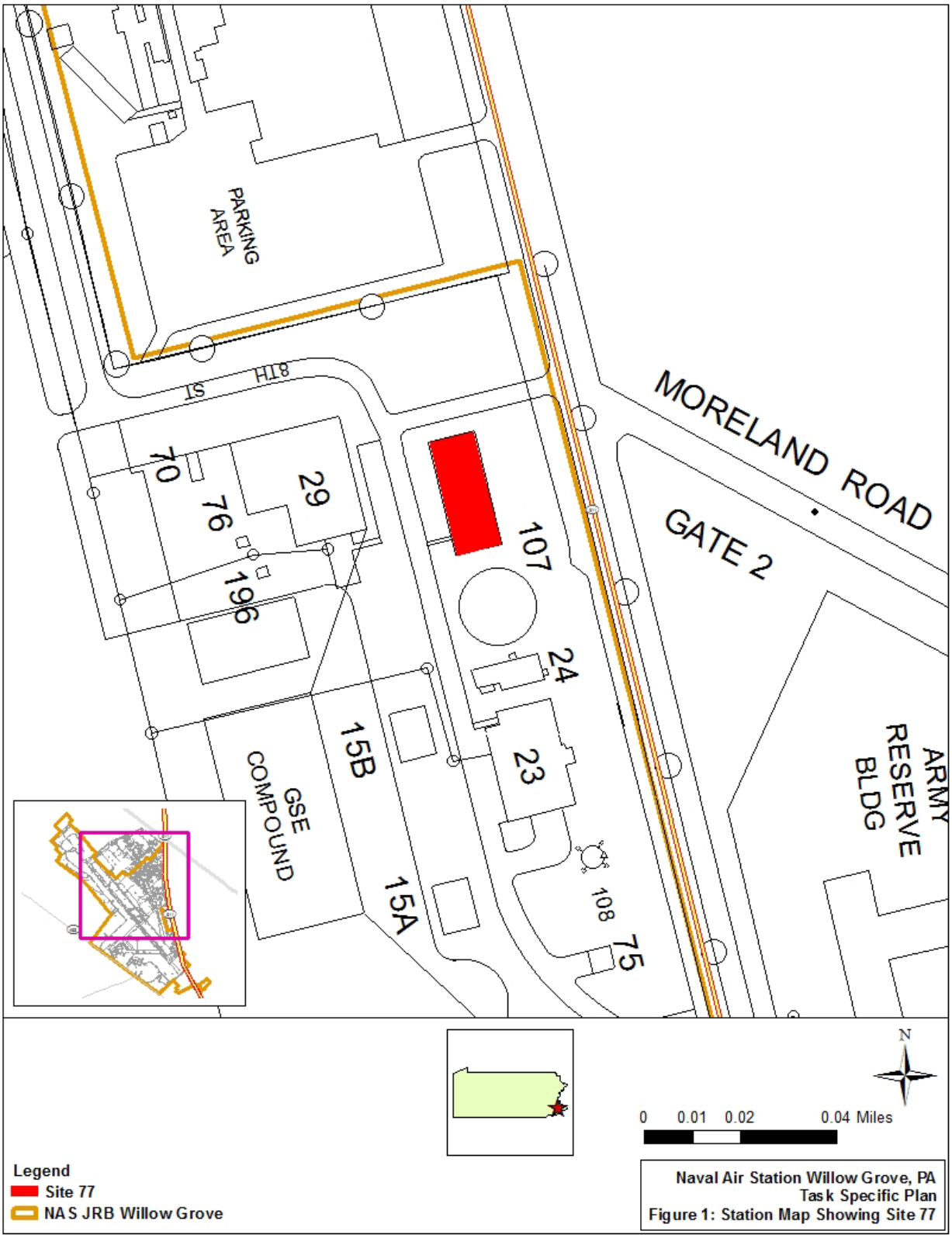
FIGURES


PARKING AREA
81ST ST
MORELAND ROAD
GATE 2
ARMY RESERVE BLDG
GSE COMPOUND
70
76
29
196
107
24
23
15B
15A
108
75
N
0 0.01 0.02 0.04 Miles
Legend
Site 77
NAS JRB Willow Grove
Naval Air Station Willow Grove, PA
Task Specific Plan
Figure 1: Station Map Showing Site 77


SU-1
A = 6,144 ft2
L = 20 ft
N
0
20
40
80 Feet
Legend
Impacted Site
NAS JRB Willow Grove Boundary
Sample Locations
Naval Air Station Willow Grove, PA
Task Specific Plan
Figure 2: Building 77 Survey Points

TABLES

TABLE 2-1 PRIMARY RADIATION PROPERTIES AND RELEASE CRITERIA FOR RADIONUCLIDES OF CONCERN

Radionuclide	Primary Radiation Properties		Release Criteria		
			Materials, Equipment, and Wastes		Release Criteria for Residential Reuse Solid Samples[c,d] (pCi/g)
	Half-life	Type	Total Surface Activity[a,b]	Removable Activity[ab]	
Sr-90	28.6 y	Beta	1,000	200	1.02
Ra-226	1,600 y	Alpha Gamma	100	20	1.0

Notes:

[a] Units are disintegrations per minute per 100 square centimeters.

[b] These limits are based on AEC Regulatory Guide 1.86 (**USAEC 1974**). Values indicate the measured value above background as determined from the reference area. Limits for removable surface activity are 20 percent of these values.

[c] These limits are based on Nuclear Regulatory Commission document NUREG-1757, Consolidated Decommissioning Guidance (**NRC 2006**), whose limits are deemed in compliance with the 25 mrem/y unrestricted dose limit in 10CFR20.1402. Listed values were developed by scaling the NUREG-1757 values to 15 mrem/y unrestricted dose.

[d] Criteria is above background for those radionuclides found in background soils.

Abbreviations and Acronyms:

pCi/g – picocuries per gram
Ra-226 – radium-226
Sr-90 – strontium 90
y – year

TABLE 3-1 SUMMARY OF DATA QUALITY OBJECTIVES

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Limits on Decision Errors**	**Optimize the Sampling Design**
The Building 77 footprint is listed as an area impacted by radiological activities. Radionuclides of concern for this Site are Sr-90 and Ra-226. It will be determined if residual contamination in surficial soil meet the site-specific release criteria for these radionuclides.	The primary use of the data expected to result from completion of this TSP is to support the Scoping Survey of the Building 77 footprint. Therefore, the decision to be made can be stated as, "Do the results of the survey meet the release criteria?"	Radiological surveys required to support the Scoping Survey of the Building 77 footprint will include: • 100 percent gamma scan surveys of the Class 3 survey units using hand-held instrumentation. Typically, a minimum of 17 biased gamma static measurements, exposure rate measurements, and solid samples will be collected in each of the Class 3 survey units. • Soil samples will be analyzed for total Sr (Sr-90) and Ra-226.	The boundaries of the survey units are shown in Figure 2. The spatial boundaries are consistent to assess radiological risks associated with residual contamination in surficial soil.	The results of the survey will be used to assess radiological risks from residual contamination in surficial soil.	Limits on decision errors are set at 5 percent, as specified in the Management Plan Revision 1 [Tetra Tech 2014a].	Operational details for the radiological survey process have been developed. The theoretical assumptions are based on guidelines contained in MARSSIM (DoD et al. 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in this TSP and the Management Plan [Tetra Tech 2014a].

Abbreviations and Acronyms:
MARSSIM – Multi-Agency Radiation Survey and Site Investigation Manual
Ra-226 – radium-226
RASO – Radiological Affairs Support Office
Sr-90 – strontium-90
TSP – Task-specific Plan

TABLE 3-2 DEFINABLE FEATURES OF WORK FOR RADIOLOGICAL SURVEYS

ACTIVITY	PREPARATORY (Prior to initiating survey activity)	DONE	INITIAL (At outset of survey activity)	DONE	FOLLOW-UP (Ongoing during survey activity)	DONE
Radiological surveys and sampling	• Verify that an approved TSP is in place. • Verify that the Remedial Project Manager, the Radiological Site Manager, and Caretaker Site Office are notified about mobilization. • Verify that an approved RWP is available, if necessary, and has been read and signed by assigned personnel. • Verify that TSP and HASP have been reviewed. • Verify that assigned personnel are trained and qualified. • Verify that personnel have been given an emergency notification procedure. • Verify that workers assigned dosimetry have completed NRC Form 4. • Verify that the relevant SOPs and/or manufacturers' instructions are available and have been reviewed for equipment to be used for radiological surveys. • Verify that equipment is on-site and is in working order (initial daily check).		• Verify that radiological instruments are as specified in the Basewide Plan and TSP. • Inspect training records. • Verify that a qualified RCT and SSO are present at active work areas. • Verify that site activities are being photographed. • Verify that the reference area measurements have been obtained using the procedure described in the Basewide Plan, which states that the same survey methodology and instruments used to collect the background data will be used to perform measurements within survey units. • Verify that daily checks were performed on all portable survey instruments. • Verify that radiological instrument calibrations and setup are current. • Verify that required dosimetry is being worn. • Verify that field logbooks, proper forms, and chain-of-custody documents are in use. • Verify that samples and measurements are being collected in accordance with the TSP, the Basewide Plan, and relevant SOPs. • Verify that sample handling and analyses are in accordance with the Basewide Plan and applicable SOPs.		• Verify that site is properly posted and secured, if necessary. • Conduct ongoing inspection of material and equipment. • Verify that a qualified RCT and SSO are present at active work areas. • Verify that daily instrument checks and background measurements were obtained and documented. • Verify that survey and sample analysis results are documented. • Verify that personnel have read and signed the revised RWP, if revision is required. • Inspect sample chain of custody and survey log for completeness. • Verify that survey and analytical activities conform to the TSP. • Verify that survey instruments are recalibrated after repairs or modifications. • Verify that site activities are being photographed. • Verify that survey documentation is reviewed by the PHP.	

Abbreviations and Acronyms:
HASP – Health and Safety Plan
NRC – Nuclear Regulatory Commission
PHP – Project Health Physicist
RCT – Radiological Control Technician
RWP – Radiation Work Permit
SOP – Standard Operating Procedure
SSO – Site Safety Officer
TSP – Task-specific Plan